

High-Energy Radiation from Thunderstorms with ADELE: TGFs, Steps, and Glows

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ABSTRACT: The biggest challenge in the study of high-energy processes in thunderstorms is getting a detector to the vicinity of the electrically active regions of a storm. The Airborne Detector for Energetic Lightning Emissions (ADELE) has been used to detect gamma rays from aircraft above storms and from a storm-chasing van on the ground. In August 2009, ADELE flew above Florida storms in a Gulfstream V jet, detecting the first terrestrial gamma-ray flash (TGF) seen from a plane and continuous glows of high-energy emission above thunderclouds. The presence of these glows suggests that a gradual process of relativistic runaway and feedback may help limit the total amount of charging in thunderstorms, in contrast to the traditional view that only lightning discharges compete with the charging process. The upper limits on TGF emission from intracloud and cloud-to-ground lightning from the ADELE flights demonstrated conclusively that a TGF of the sort seen from space is not associated with most lightning and not necessary to trigger it. In August 2010, observations from a van detected stepped-leader x-ray emission from at least four lightning strikes in ten days of operations. This mode of operation is therefore promising for future observations of the stepping process, although a more varied suite of instrumentation, in particular a flash-distance detector, would be useful. We will report on these results and on future possibilities for ADELE campaigns.

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